CLAIMS

What is claimed is:

1. A method for correcting for systematic errors in the writing of timing patterns on a storage medium of a storage device, said method comprising:

measuring a time interval between a trigger pattern written at a first radial position of said storage medium and a rotational index, said rotational index being related to the rotational orientation of the storage medium with respect to a fixed frame of said storage device; and

shifting location of another trigger pattern to be written, said shifting using said measured time interval in determining the shift in location for said another trigger pattern.

2. The method of claim 1, further comprising computing an index correction value from a deviation between the measured time interval and another time interval, wherein said using uses said index correction value to shift said location of said trigger pattern.

3. The method of claim 2, wherein said computing comprises subtracting said another time interval from the measured time interval to obtain said index correction value.

4. The method of claim 1, further comprising determining whether said measured time interval is valid.

5. The method of claim 4, wherein said determining comprises comparing said measured time interval to a first value to determine whether said measured time interval is valid, said first value comprising a function of a target index time and an allowed error from the target.

6. The method of claim 5, wherein said function comprises a summation of said target index time and said allowed error, and wherein said measured time interval is redetermined when said measured time interval is greater than said first value.

7. The method of claim 6, further comprising comparing said measured time interval to a second value when said first value is less than or equal to said measured time interval, said second value comprising a difference between said target index time and said allowed error from the target, wherein said measured time interval is invalid when said measured time interval is less than said second value.

8. The method of claim 7, further comprising:

determining whether a trigger pattern valid flag is valid, when said measured time interval is greater than or equal to said second value; and

updating an index estimate to be used in correcting one or more interval measurements, when said trigger pattern valid flag is valid and when said measured time interval is greater than or equal to said second value.

9. The method of claim 8, wherein said shifting comprises using said updated index estimate, which is a function of said measured time interval, in determining said shift.

10. The method of claim 4, further comprising updating an index estimate to be used in correcting one or more interval measurements, when said measured time interval is valid.

11. The method of claim 1, further comprising determining whether said trigger pattern is within an expected trigger pattern region.

12. The method of claim 11, wherein said determining comprises:

measuring an interval at said trigger pattern;

correcting said measured interval for any previous invalid trigger patterns; and

determining whether said corrected measured interval is valid, wherein a valid corrected measured interval indicates said trigger pattern is within said expected trigger pattern region.

13. The method of claim 12, wherein said determining whether said corrected measured interval is valid comprises:

subtracting a target interval value for said trigger pattern from said measured interval to obtain a resulting value; and

comparing an absolute value of said resulting value to a valid interval window to determine whether said corrected measured interval is valid, wherein said corrected measured interval is valid when said absolute value of said resulting value is less than or equal to said valid interval window.

14. The method of claim 13, further comprising modifying said valid interval window when said corrected measured interval is invalid.

15. The method of claim 1, further comprising using a detector to detect whether said trigger pattern is at an expected location on said storage medium at a given time.

16. The method of claim 15, further comprising generating said trigger pattern, as a false trigger pattern, when said trigger pattern is not detected at said given time.

17. A method for correcting for systematic errors in the writing of timing patterns on a storage medium of a storage device, said method comprising:

determining a systematic delay for use in writing at least one trigger pattern at one radial position of said storage medium; and

updating said systematic delay for use in writing at least one trigger pattern at another radial position of said storage medium, wherein said updated systematic delay is different from said systematic delay for use in writing at said one radial position.

18. The method of claim 17, wherein said updating comprises:

correcting one or more measured intervals of trigger patterns written at said one radial position;

computing a half/full measurement for said one or more corrected measured intervals;

updating a half/full error using said computed half/full measurement;

computing a delay correction using said half/full error; and

using said delay correction in updating said systematic delay.

19. The method of claim 18, wherein said updating comprises adding said delay correction to said systematic delay to obtain said updated systematic delay.

20. The method of claim 17, wherein said updating comprises using an index correction value indicative of the location of said at least one trigger pattern at said one radial position relative to a rotational index of the storage medium.

21. A method for correcting for systematic errors during self-servowriting of a storage device, said method comprising:

a) measuring a systematic error at a plurality of predetermined radial positions, wherein a measured systematic error for each of said plurality of predetermined radial positions having a mean whose absolute value is greater than zero is determined; and

b) correcting for each of the measured systematic errors in order to reduce said measured systematic errors.

22. The method of claim 21, wherein random errors in the placement of servo patterns are also corrected.

23. A method for self-servowriting a storage medium in a storage device including a head positioned for interaction with the storage medium, comprising:

writing a first set of trigger patterns on a first track of said storage medium;

determining a read to write time delay;

determining an index correction value;

determining at least one random error correction value;

computing a set of delay values which are a function of said read to write time delay, said index correction value and said at least one random error correction value; and

triggering from said first set of trigger patterns and writing a second set of trigger patterns on a subsequent track using said set of delay values.

24. The method of claim 23, wherein said determining said read to write time delay comprises:

writing a first trigger pattern at a first position on said storage medium;

triggering on said first trigger pattern and writing a second trigger pattern at a nominal time T;

measuring a time interval between said first and said second trigger patterns; and

computing a difference between said time interval and the nominal time T to determine said read to write time delay.

25. A method for correcting for systematic errors in the writing of timing patterns on a storage medium by a head of a recording device, said method comprising:

detecting one or more circumferential systematic errors; and

correcting for said one or more circumferential systematic errors.

26. The method of claim 25, wherein said detecting comprises computing an integral correction value for a time interval, wherein a non-zero integral indicates a circumferential error.

27. The method of claim 26, wherein said computing comprises adding a random error correction for said time interval to said integral correction value to obtain said integral correction value.

28. The method of claim 27, wherein said correcting comprises calculating a target interval for said time interval, said calculating using said integral correction value.

29. An apparatus for correcting for systematic errors in the writing of timing patterns on a storage medium of a storage device, said apparatus comprising:

a measuring unit adapted to measure a time interval between a trigger pattern written at a first radial position of said storage medium and a rotational index, said rotational index being related to the rotational orientation of the storage medium with respect to a fixed frame of said storage device; and

a controlling unit adapted to shift location of another trigger pattern to be written, said controlling unit using said measured time interval in determining the shift in location for said another trigger pattern.

30. The apparatus of claim 29, further comprising a computing unit adapted to compute an index correction value from a deviation between the measured time interval and another time interval, and wherein said controlling unit uses said index correction value to shift said location of said trigger pattern.

31. The apparatus of claim 30, wherein said computing unit is further adapted to subtract said another time interval from the measured time interval to obtain said index correction value.

32. The apparatus of claim 29, wherein said controlling unit is further adapted to determine whether said measured time interval is valid.

33. The apparatus of claim 32, wherein said controlling unit is further adapted to compare said measured time interval to a first value to determine whether said measured time interval is valid, said first value comprising a function of a target index time and an allowed error from the target.

34. The apparatus of claim 33, wherein said function comprises a summation of said target index time and said allowed error, and wherein said measured time interval is redetermined when said measured time interval is greater than said first value.

35. The apparatus of claim 34, wherein said controlling unit is further adapted to compare said measured time interval to a second value when said first value is less than or equal to said measured time interval, said second value comprising a difference between said target index time and said allowed error from the target, wherein said measured time interval is invalid when said measured time interval is less than said second value.

36. The apparatus of claim 35, wherein said controlling unit is further adapted to:

determine whether a trigger pattern valid flag is valid, when said measured time interval is greater than or equal to said second value; and

update an index estimate to be used in correcting one or more interval measurements, when said trigger pattern valid flag is valid and when said measured time interval is greater than or equal to said second value.

37. The apparatus of claim 36, wherein said controlling unit is further adapted to use said updated index estimate, which is a function of said measured time interval, in determining said shift.

38. The apparatus of claim 32, wherein said controlling unit is further adapted to update an index estimate to be used in correcting one or more interval measurements, when said measured time interval is valid.

39. The apparatus of claim 29, wherein said controlling unit is further adapted to determine whether said trigger pattern is within an expected trigger pattern region.

40. The apparatus of claim 39, wherein said controlling unit is further adapted to:

measure an interval at said trigger pattern;

correct said measured interval for any previous invalid trigger patterns; and

determine whether said corrected measured interval is valid, wherein a valid corrected measured interval indicates said trigger pattern is within said expected trigger pattern region.

41. The apparatus of claim 40, wherein said controlling unit is further adapted to:

subtract a target interval value for said trigger pattern from said measured interval to obtain a resulting value; and

compare an absolute value of said resulting value to a valid interval window to determine whether said corrected measured interval is valid, wherein said corrected measured interval is valid when said absolute value of said resulting value is less than or equal to said valid interval window.

42. The apparatus of claim 41, wherein said controlling unit is further adapted to modify said valid interval window when said corrected measured interval is invalid.

43. The apparatus of claim 29, further comprising a detector adapted to detect whether said trigger pattern is at an expected location on said storage medium at a given time.

44. The apparatus of claim 43, further comprising a pattern generator adapted to generate said trigger pattern, as a false trigger pattern, when said trigger pattern is not detected at said given time.

45. An apparatus for correcting for systematic errors in the writing of timing patterns on a storage medium of a storage device, said apparatus comprising:

a processing unit adapted to determine a systematic delay for use in writing at least one trigger pattern at one radial position of said storage medium; and

said processing unit being further adapted to update said systematic delay for use in writing at least one trigger pattern at another radial position of said storage medium, wherein said updated systematic delay is different from said systematic delay for use in writing at said one radial position.

46. The apparatus of claim 45, wherein said processing unit is further adapted to:

correct one or more measured intervals of trigger patterns written at said one radial position;

compute a half/full measurement for said one or more corrected measured intervals;

update a half/full error using said computed half/full measurement;

compute a delay correction using said half/full error; and

use said delay correction in updating said systematic delay.

47. The apparatus of claim 46, wherein said processing unit is further adapted to add said delay correction to said systematic delay to obtain said updated systematic delay.

48. The apparatus of claim 45, wherein said processing unit is further adapted to use an index correction value indicative of the location of said at least one trigger pattern at said one radial position relative to a rotational index of the storage medium in updating said systematic delay.

49. An apparatus for correcting for systematic errors during self-servowriting of a storage device, said apparatus comprising:

a measuring unit adapted to measure a systematic error at a plurality of predetermined radial positions, wherein a measured systematic error for each of said plurality of predetermined radial positions having a mean whose absolute value is greater than zero is determined; and

a controlling unit adapted to correct each of the measured systematic errors in order to reduce said measured systematic errors.

50. The apparatus of claim 49, wherein said controlling unit is further adapted to correct for random errors in the placement of servo patterns.

51. An apparatus for self-servowriting a storage medium in a storage device including a head positioned for interaction with the storage medium, comprising:

a first set of trigger patterns written on a first track of said storage medium;

a controlling unit adapted to determine a read to write time delay, an index correction value, and at least one random error correction value;

a computing unit adapted to compute a set of delay values which are a function of said read to write time delay, said index correction value and said at least one random error correction value;

a pattern detector adapted to trigger from said first set of trigger patterns to write a second set of trigger patterns; and

a pattern generator adapted to write said second set of trigger patterns on a subsequent track using said set of delay values.

52. The apparatus of claim 51, wherein said controlling unit adapted to determine said read to write time delay comprises:

a pattern generator adapted to write a first trigger pattern at a first position on said storage medium;

a pattern detector adapted to trigger on said first trigger pattern, wherein said pattern generator writes a second trigger pattern at a nominal time T;

a measuring unit adapted to measure a time interval between said first and said second trigger patterns; and

a computing unit adapted to compute a difference between said time interval and the nominal time T to determine said read to write time delay.

53. An apparatus for correcting for systematic errors in the writing of timing patterns on a storage medium by a head of a storage device, said apparatus comprising:

a controlling unit adapted to detect one or more circumferential systematic errors; and

said controlling unit being further adapted to correct for said one or more circumferential systematic errors.

54. The apparatus of claim 53, further comprising a computing unit adapted to compute an integral correction value for a time interval, wherein a non-zero integral indicates a circumferential error.

55. The apparatus of claim 54, wherein said computing unit is further adapted to add a random error correction for said time interval to said integral correction value to obtain said integral correction value.

56. The apparatus of claim 55, wherein said controlling unit is further adapted to calculate a target interval for said time interval, using said integral correction value to correct for said one or more circumferential errors.

57. A storage device comprising:

a storage medium; and

a head radially positioned by an actuator, said head adapted to write a self-servo timing pattern on said storage medium, wherein systematic errors are eliminated and rotation of said servo-pattern matches a trajectory traced out by the head in its radial motion across the storage medium.

58. The storage device of claim 57, wherein said head is adapted to write said servo-pattern such that random errors in a track to track alignment of the servo-patterns are statistically constant in their root mean square value across at least a desired portion of a surface of the storage medium.

59. The storage device of claim 57, wherein said head is adapted to write said servo-pattern such that random errors in a track to track alignment of the servo patterns are corrected in a manner that leads to a growth of errors that is less than the square root of the track number typical of a random walk process.

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